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CHAPTER 1

INTRODUCTION

1.1 Background of the Problem

The factors affecting achievement and cognitive processes of students have been a matter of concern amongst educators. Many studies have been conducted to find the various factors affecting achievement and cognitive processes (Ngo & Lee 2007; Zohar 2004; Adey & Shayer 1990; Rennie & Punch, 1991; Watson, 1991). Lee & Luykx (as cited by Alder & Mckelvey, 2004) attribute a number of factors for achievement gaps, and one of the factors mentioned is instructional strategies. They further indicate that the lecture method and recitation are both time tested strategies from time immemorial but have its own limitations. Probably one of the drawbacks of lecture method is, the learner is passive and it might be said the method is only helping in “transmission of data” (Kelly, 1978). Another problem mentioned by Koretz & Barron (1999) in their study (as cited by Alder & Mckelvey, 2004) is that the lecture method can “move higher order skills to background”.

When the teacher has to complete the syllabus within the stipulated time, he/she is compelled to resort to lecture method. The lecture method is a pedagogical tool which cannot be substituted; it is a strong teaching tool when used properly. But there is a tendency of over using this pedagogy in the classroom. This trend is seen especially in the classrooms of our country.

In the sub continent of India, science teaching in schools is primarily oral. The teacher recites the book knowledge. There is virtually no practical work, and the
teacher is mainly concerned with “finishing” the prescribed textbook, and preparing students for government examinations. It seems the schools are competing with each other to declare excellent results and high passing percentage. According to Patkar, (Education Times, Feb: 7, 2006) this makes one wonder “whether the schools are factories churning out the students as their products” with no meaningful learning.

This is partly because of the large student enrollment in a class (Devi, 1999), and students aspiring to get good marks to compete for admissions in engineering and medical colleges (Kapur, 2002; Khattar, Education Times, 2008). Students, therefore, hardly make meaningful connections between their personal ideas and the learned subject. This leads to a “clutter of ideas,” which students cannot use in open ended problem solving situations (Rao, 2003). The present scenario is seen from the sixties. Bharambe (1997) quotes, The Report of the Education Commission (1964-66) that “In the average school today, instruction still conforms to a mechanical routine, continues to be dominated by the old besetting evil of verbatim and therefore remains as dull and uninspiring as before”. She also mentioned in her study that many students due to lack of attention and participation refrain from understanding the patterns of logical organization and they do not apply their mind to discussion.

1.2 The Context

The researcher had the schooling in the traditional set up and was a teacher in the school for more than 20 years. It was always the researcher’s passion to explore new ways of teaching so that learning becomes effective and moves away from the regular monotony of traditional methods. Further more, researcher could feel in the changed scenario, with many newer stimuli, through various media all around, the
students require innovative science methods to capture their mind, to analyze and articulate the natural phenomena around them.

1.2.1 The Preliminary Study.

In the present Indian scenario change is seen in various spectrum of education, and the researcher sought every opportunity to grow professionally so that the researcher could become better equipped in the changed scenario of Science Education. The researcher being a senior teacher at Spicer Memorial College was constantly on the look out for innovative teaching models to improve student learning and achievement. In June 2004, the researcher attended a seminar at Spicer Memorial College conducted by Dr. Jazlin Ebenezer, Professor of Science Education at Wayne State University, MI, USA. The topic of discussion at the seminar was a teaching and learning model known as the \textit{Common Knowledge Construction Model (CKCM)} (Ebenzer & Connor 1998), anchored in scientific knowledge development, science learning, and contemporary science education standards.

1.2.2 Theoretical Framework of Common Knowledge Construction Model (CKCM).

CKCM of teaching and learning consists of four interactive phases: (1) Exploring and Categorizing; (2) Constructing and Negotiating; (3) Translating and Extending; (4) Reflecting and Assessing (see Appendix A, Figure A.1).

\textbf{Exploring and Categorizing}: In the first phase, before a unit of study begins, the teacher encourages students to explore their ideas of a natural phenomenon or physical system. For example, engaging students in making their personal or
collective concept maps based on a science concept or task reveals their prior understanding. These ideas are used as conceptual handles in the construction and negotiation of knowledge.

**Constructing and Negotiation:** In this phase, students’ ideas are subjected to experimentation. Students research materials from various sources. They are engaged in critical discourse with peers and the teacher. Much collaborative work occurs. A move from a personal conception to scientific explanation based on critical inquiry is the hallmark of this phase. Construction of ideas may involve concept mapping. Students’ initial map is compared to the evolving conceptual networks to assess development of knowledge. Missing concepts and links are identified and brought to students’ attention. Through teacher mediation, the maps are continuously reconstructed. With a deep understanding of the core concepts, students enter into phase three.

**Translating and Extending:** The constructed knowledge is used to shape scientific inquiries of social issues. Students engage in the investigation of science related societal problems. The two pedagogical elements that this phase emphasizes are decision – making and action – taking within the inquiry of open-ended problems that considers alternative positions (Means & Voss 1996; Zohar & Nemet, 2002)

**Reflecting and Assessing:** This is an integral part of the learning phases described above. Reflecting suggests students loop back to their original thoughts and track how their ideas have changed. Formative assessment is built into the learning process. Not all assessments are defensible. Traditional test items such as fill – in the blanks, matching and multiple choices give way to assessments such as concept mapping (Novak 2002) Concept mapping assessment measures how students explore, expose, revise or reject their conceptions. Through concept maps, the small steps that students
take to understand difficult science concepts may be tracked. What concepts need to be further explored may be revealed through student constructed concept maps.

1.2.3 The Rationale of the Preliminary Study.

Demonstration of an innovative model (CKCM) by Dr. Jazlin Ebenezer during the seminar triggered the researcher to try out the model in the school for professional development and to get a feel for the intricacies of the model in Indian set up. Thus began the researcher’s conversations with Dr. Ebenezer during the subsequent three week long train journey from Pune to South India. The researcher corresponded with her through numerous e – mails and collaboratively conducted a classroom based study on the application of the CKCM to a unit on Excretion in Biology for Standard Seven students in 2004. Together with Dr. Ebenezer and co – authors, the researcher disseminated this important research in national and international conferences and in the Journal of Research in Science Teaching: “Effect of Common Knowledge Construction Model Sequence of Lessons on Science Achievement and Relational Conceptual Change”

1.2.4 The Objective of the Preliminary Study

The CKCM study was guided by the following objectives:

1) Do lessons modeled on CKCM enhance the achievement of the students
2) Do lessons taught based on CKCM affect the conceptual change of the students.

This study was the preliminary study for the researcher and a number of strategies along with concept mapping were incorporated into it.
1.2.5 Methodology of the Preliminary Study

The design used for the study was a mixed design with quantitative and qualitative approach. At random two sections of standard seven were taken and the sample was comparable in all aspects. The prior achievement tests shows performance in science was equivalent for both the groups. The control group was taught by the regular teacher in the traditional method and the experimental group was taught by the researcher. Observers were present in the class to check the style of teaching and to monitor the teaching and to receive the feedback from the students.

The grades for the unit test conducted after the experiment became the data for the first objective and the observations, interviews, questionnaire, Brochures, prior conceptions, delayed post conceptions and tape recorder recordings formed the data for the second objective.

1.2.6 Results of the Preliminary Study

The achievement was higher for the experimental group as well as the experimental group denoted higher change in the conceptions. Another interesting aspect of the study was an increased number of students instantly took a liking for concept mapping strategy. They started incorporating it into the delayed post conceptions as well as in the Brochure making activity. (See Appendix A.2)

1.3 Outcome of the CKCM Study for the Present Study

The CKCM connected study was presented for the International Conference EPISTEME - 1 in Goa hosted by Homi Bhaba Center of Science Education (HBCSE) Mumbai in 2004. Later it was presented as a poster for National Association for Research in Science Teaching (NARST) 2006 in San Francisco, USA. Again Journal
of Research in Science Teaching (JRST) the official journal of NARST accepted this collaborative work in 2008. This interesting study gave confidence to the researcher to plunge into the present study. Rather than testing the efficacy of the CKCM the researcher focused on concept mapping, a significant teaching, learning tool of the Common Knowledge Construction Model (CKCM).

A number of teaching strategy such as Idea Splash, Predict Explain, Observe Explain (PEOE), Journal writing, Brochure making, Concept Mapping, Discussion, questioning, narration etc were used in the preliminary study on CKCM. Also in Dr. Ebenezer’s book _Becoming Secondary School Science Teachers: Pre service Teachers as Researchers_ a number of concept maps were used to explain various concepts. Her model was depicted interconnected with learning science using a concept map (see Appendix A. figure A 4). Observation of these concepts maps in various situations interested the researcher. During the study, even students demonstrated their conceptions using concept maps. Students constructed the brochures also using the concept maps (see Appendix A. Figure A.2) A number of discussion with many experts in education highlighted the importance of concept maps and the researcher could see in the International conference of Episteme 1 in Goa many researchers were using Concept maps for their studies,(Mathai & Ramadas 2004; Gopal 2004; Kharatmal & Nagarjuna 2004; Rajwade, Panse & Pradhan 2004; Rao 2004) . In this conference Gopal (2004) used concept map as a pedagogical tool in English, Rao, (2004) used it as a pedagogical tool in science. Rao (2004) studied the effect of concept mapping on science achievement, cognitive skills and attitude for standard eight students of state run school in Mysore.
The interest in the concept map made the researcher to read more as well as write to Dr. Joseph Novak (see Appendix A. photo A. 3) the developer of concept map. At present he is the Professor Emeritus, Cornell University, Ithaca, and senior scientist of Institute of Human and Machine Cognition (IHMC.) USA. He wrote to the researcher immediately and suggested to check the website (cmap.ihmc.us/Publications/ResearchPapers/TheoryCmaps/TheoryUnderlying Concept Maps.htm) for information’s regarding researches and informed about the International Conference meeting exclusively for concept mapping every two years. Dr. Novak encouraged the researcher in the present study and sent a copy of a recent study conducted by Trifone (2006) in which he was also involved.

1.4 The Rationale & Felt need for the Present Study

Seidel & Shavelson (2007) have mentioned that teaching components have an effect on students’ cognitive growth. The degree the components are present in teaching affects student learning. The general perception among the public is that the English medium schools have all the teaching components that can improve student learning. But the question is, “Are the meritorious English medium schools of the metros considered to be the ‘ivory towers of thought’, able to reach higher degree of student learning?”

India Today, November, 27, 2006 published (Chengappa & Maheshwari, 2006) a survey conducted by Wipro Applying Thought in Schools &Educational Initiatives (EI) in February and April of 2006 in 142 of India’s top private schools spread across five metros. They tested learning and understanding of key concepts in English, Mathematics and Science taking over 32,000 students in classes IV, VI and VIII, as the sample. It was found out that there is an alarming gap in student learning.
Learning was found to be mechanical. The performance was exceedingly well for rote based learning. Questions related to application were far below acceptable levels. Student’s learning is rote – based and does not focus on real learning and they fail in analysis and interpretation. The survey also showed that in subjects such as Mathematics and Science our students performed far below the International average. Dr.K. Subramaniam a professor of Homi Bhabha Centre for Science Education, who was a member of the expert panel which analyzed the survey said, “It’s clear from the survey that our top schools have very unsatisfactory learning. That children are not using their minds and there is something that is putting their thinking and analytical abilities off. The survey strikes at the core of the problem gnawing our educational system – the focus on high scores in board exams rather than concentrating on real learning”.

In August 2007 Educational Initiatives conducted a study titled, *Assessment of Scholastic Skills through Educational Testing* (ASSET) and found that students across the classes, answer rote based or procedural questions relatively well but seemed lost on application of the concepts.(Khattar, 2008)

The National Curriculum Framework for School Education (2000) developed by the NCERT clearly states that the child is the constructor of knowledge (section 1.14.13). The document reiterates the active role of the child in constructing knowledge through hands- and minds-on experiences. NCERT discourages imitation and memorization of the material and encourages peer collaboration and support, discussions, and self-observation. After five years, the National Curricular Framework (2005) explicitly states, “The curriculum engage the learner in acquiring the methods and processes that lead to generation and validation of scientific knowledge, and nurture the natural curiosity and creativity of the child in science” (p 44).
In line with this assertion, the NCF further reiterates that the pedagogy needs to be changed: Chapter 3 of the NCF (2.2, 2.4) says Scientific concepts are to be arrived at mainly from activities and experiments and child centered approaches need to be taken.

Clearly NCERT is calling for a radical change--the transmission model giving way to constructivist models of learning that promote constructing personal meanings and moving to “fit” more scientific ideas through critical thinking (Rao, 2003). The learning environment is slowly changing (Joseph, 2000). The winds of awareness and change are echoed through many educators – Sita Laxmi Vishwanath, Principal, Amirta Vidyalam, Chennai says “I strongly feel that there should be a model that encourages concepts well, there won’t be a need to mug up. The teaching methodology should be more activity based” (Khattar, 2008). Despite these constraints, the Indian science education system is educating the masses and producing many of the finest minds in the world. Without the Indian entrepreneurs, Silicon Valley would not be what it is today (Panaguriya, 2001). While a few motivated students are able to withstand the educational system and achieve success, quite often educationists and the public domain indicates that, memorization of scientific facts is still the norm (Chengappa & Maheshwari, 2006; Patkar, 2006).

Bharambe (1997) has reported from the 1964-66 Education commission that one of the factors that impede progress in pedagogy upgradation is the failure to develop proper educational research on teaching methods. She further states the critical evaluation of Bhatanagar on Kothari Commission as follows, “Kothari Commission blames the rigidity of the educational system for the dull and uninspiring school teaching today. There should be a general atmosphere of reform. Experimental
efforts should be encouraged and new methods of teaching diffused among all schools and teachers. The diffusion of new methods is necessary”.

A change in the model of teaching is required, so that the child makes meaningful connections between his/her prior concepts with new knowledge. For achieving this in the class room the teacher and the student need to actively engage in making meaningful connections.

One of the strategies that have evolved as a useful tool in leading students towards meaningful learning is ‘Concept map’. This was noticed in the earlier study. This strategy is based on Constructivist Cognitive Based Model, which is designed to engage the learner in the active processing of information throughout the learning experience (Glatthorn & Coble, 1993).

The use of concept maps as a teaching strategy was first developed by J. D. Novak of Cornell University in the early 1980's. It was derived from Ausubel's learning theory which places central emphasis on the influence of students' prior knowledge on subsequent meaningful learning. He says that when meaningful learning occurs there is a series of new connections being formed between the concepts and hence meaningful learning is more powerful than rote learning (Novak 2006; Canas & Novak, 2006). Student generated concept map is a semantic network with nodes, links and crosslink’s that reveals relationships among concepts (Novak 2006; 1998; Novak & Gowin, 1984). A concept map provides a visual lens of learners’ limited or inappropriate hierarchical propositions and cross – links that require conceptual change (Novak, 2002).

Studies have been conducted in the United States and else where using concept maps. In India, research in this area is limited. Recent studies indicate that concept mapping as a pedagogical tool has improved student achievement in various
subjects (Raghavan 1991; Gopal 2004; Rao, 2004; Kharmatal & Nagarjuna 2006). But this needs to be further validated with an in-depth study. In the above context, the present study has been selected to find the effectiveness of concept mapping as a tool in pedagogy to help the pupil improve their cognitive processes and scholastic performance.

1.5 Statement of the Problem

Taking into consideration the above discussion the statement of problem for this study is as follows:

“Effect of Concept mapping on the Cognitive Processes and Scholastic performance in General Science for Standard VII Students within Pune City”

1.6 The Purpose of the Study

This study endeavors to assess the use of concept mapping as a pedagogical tool. By this study the researcher would find the impact of Concept Mapping as a pedagogical tool, which will help the development of Cognitive Processes. The study also would elaborate on the effect of Concept Mapping on the Scholastic Performance in General Science. Further the study endeavors to portray the effective use of a simple pedagogical tool in a class room situation where sophisticated technology is not available.

With the problem at hand, the researcher formulated some questions to give a clear direction and purpose to the study. The questions that guided the study are as follows:
1. Do lesson sequences designed using Concept Maps significantly improve standard VII students’ cognitive processes?

2. Do lesson sequences designed using Concept Maps significantly improve standard VII students’ achievement in General Science (Chemistry, Biology) during the course of study as compared to the traditional method of teaching?

3. What is the opinion of the students on lesson sequences designed using Concept Maps affecting their learning process?

1.7 Objectives of the Study

The following research objectives were formulated based on the purpose:

1. To study the effect of concept mapping on the cognitive processes of standard VII students in General Science.

2. To study the impact of teaching through Concept Mapping on the achievement of standard VII students in General Science (Chemistry, Biology).

3. To investigate the opinion of the students on concept mapping as pedagogical tool in the learning process.

1.8 Hypotheses

The hypotheses were formulated on the basis of the research objectives and the variables under study. The literature and related areas were appraised to generate the hypotheses. In the literature no study has been mentioned where the selected dependant variables, subjects and population were similar. Therefore the following null hypotheses were formulated for the present study.
**Hypothesis: I.** There is no statistically significant difference in the Cognitive Processes, between the experimental group and control group.

**Sub Hypothesis:**

1. There is no statistically significant difference in the Cognitive Processes (mental abilities), between experimental group and control group.
2. There is no statistically significant difference in the Cognitive Processes (mental abilities), between the experimental group and control group, in the selected units of General Science (Chemistry & Biology).
3. There is no statistically significant difference in the Cognitive Processes (mental abilities), between the experimental group and control group in the selected units of Chemistry.
4. There is no statistically significant difference in the cognitive Processes (mental abilities), between the experimental group and control group in the selected units of Biology.

**Hypothesis: II.** There is no statistically significant difference in the achievement, between the experimental group and control group.

**Sub Hypothesis:**

1. There is no statistically significant difference in the achievement, between the experimental group and control group in selected units of General Science.
2. There is no statistically significant difference in the achievement, between the experimental group and control group in selected units of Chemistry.
3. There is no statistically significant difference in the achievement, between the experimental group and control group in selected units of Biology.
**Hypothesis III** More than 50% of the students subjected to the treatment indicate improvement in their learning process due to the use of concept map as a pedagogical tool as measured by the Trifone (2006) opinionnaire.

**1.9 Significance of the Study.**

The testing of the hypotheses enables a teacher to develop the capacity in designing and testing concept mapping as a strategy to enhance meaningful learning. When evidence reveals that standards-based teaching models work for teachers, and when teachers themselves design lessons and implement them in the complex classroom settings, then there is teacher-desire to adopt defensible strategy such as concept mapping.

With respect to professional development, exploring new avenues of teaching strategy contributes to the professional development of a teacher to critically examine new directions into teaching. When such research is reported through a public venue, it helps the reader to situate oneself into a different mode of teaching, and critically examine the value of this sort of teaching for conceptual development of the learner. Experimentation with contemporary pedagogical tools such as the concept mapping in a classroom at the interface of students contributes to high quality professional development, and it is much needed if we are to influence students’ science achievement, conceptual development, and students’ interests toward science.

The broader impact is, answering the first research question adds to the meager literature on development of cognitive processes (mental abilities) using concept mapping. Answering the second question contributes to the literature on the effects of standards-based teaching strategy on students’ achievement. In India this strategy is in the beginning stage with Andal (1991), Rao (2004) in Biology, Gopal...
(2004), in Grammar lessons, Rajwade, Panse & Pradhan (2004) in physics have done some preliminary studies with varied implications. This study is important because this is one of the in-depth studies conducted for 12 weeks with concept mapping as a pedagogical tool in the science classroom setting.

The study is important because it also tries to assess students’ opinion towards concept mapping as a pedagogical tool in the learning process. This method is a simple teaching strategy which the teacher and the student can use with minimal resources for enhancing the learning process. The strategy helps the student to be active, thinking, articulating the concepts and constructing the concepts. It helps the student to produce new connections in the brain.

1.10 Limitations

The study is with human population and is vast in nature. The study has varied limitations due to the human element and the organizational set up.

1. The validity of the study is greatly influenced by the accuracy of the responses given by the students concerned.

2. The number of subjects in the study depends on the equivalent group selected from the standard seven of the school.

3. Randomization of the whole population by the researcher is not possible because the students are enrolled in various schools and within the school they are put in different sections at random. Hence it is a quasi – experimental study.
1.11 Delimitations

The researcher was aware of the wide scope of the subject area and so the study was delimited to:

1. The use of Concept Maps in the teaching – learning situation
2. Chemistry and Biology, the branches of General Science. The third branch Physics is omitted from the study.
3. Selected units of Chemistry, Biology, (General Science)
4. Dependant variables such as achievement, and higher mental abilities such as application, analysis, synthesis, evaluation..
5. One school from the 10 Indian Certificate Secondary Education (ICSE) schools in Pune,
6. From the enrolled group of students’ only students who have equivalent mental abilities were selected for the study.

1.12 Description of Terms used in the Study.

Cognitive Processes:

According to Good (as cited by Sansanwal, 1989) higher mental processes is one of the complex forms of mental activity involving highly organized processes. The processes involved are reasoning, memory, imagination, aspiration or voluntary attention. According to Sansanwal, (1989) the above description given by Good refers to the Higher Mental abilities of the cognitive domain explained by Bloom.

Bloom et al in (1956) has worked on the Taxonomy of Educational Objectives and classified the instructional objectives into three domains- cognitive, affective, and psychomotor. The cognitive domain includes knowledge comprehension, application, analysis, synthesis and evaluation. A sharp line is suggested in the taxonomy between
“knowledge” and five higher levels which involve “intellectual abilities and skills” (Stanley & Hopkins 1978)

**Academic (Scholastic) Achievement:** It is the measure of what an individual has learned in his or her present level of performance. Achievement test scores are helpful in determining individual or group status in academic learning. They are used in evaluating the influences of courses of study, teachers, teaching methods and other factors considered to be significant in educational practice. (Best & Kahn, 2003)

The **Council for the Indian School Certificate Examinations** (often abbreviated as CISCE ) is a board of school education in India. It conducts two examinations in India: the Indian Certificate of Secondary Education (ICSE) and the Indian School Certificate(ISC). The CISCE was set up in 1958 by the University of Cambridge local Examination Syndicate with the assistance of the Inter – State Board for Anglo – Indian Education. It is registered under the Societies Registration Act No XXI of 1860.

The Indian Certificate of Secondary Education (ICSE) Examination is a K010 public board examination for students in India who have just completed Class X (equivalent to the first two years of the 4 year High School programme). Seven subjects are compulsory to be taken by the candidates, which may consist of English, an Indian language like Hindi, Environmental Education, General Science(consisting of Physics, Chemistry and Biology), Social studies( which includes Geography, Indian history, World history and Civics), Mathematics, Computer Science, Commerce or various other subjects.

Similarly, the Indian School Certificate (ISC) Examination is a K- 12 public board examination for those completing Class XII (equivalent to the end of the 4 year High School programme). It examines five subjects ([http://www.cisce.org/Council.html](http://www.cisce.org/Council.html))
**Pune city:** Pune is the second largest city in Maharashtra. It is the 8th largest urban agglomeration in India with a population of 5 million, and is the administrative capital of Pune district. It is situated 560 metres above the sea level on the Deccan Plateau at the confluence of river Mula and Mutha. Pune rose to prominence in the 17th century as the seat of Peshaws. It was brought under British India in 1817 and became the ‘monsoon capital’ of Bombay presidency. Now Pune is known for the educational facilities with over an hundred educational institutes and nine universities. It is also a growing hub for IT and Automobiles industry. (Wikipedia, Free Encyclopedia, Pune, 2008) Pune may be divided into the following four zones:

1. Central Pune City (the Peths).

2. Inner Pune City: West-Central Pune City such as Deccan, Erandwane, Shivajinagar. East-Central Pune City such as Camp, Dhole Patil road, Koregaon Park. South-Central Pune City such as Swargate, Parvati, Mukundnagar - Maharshinagar, Gultekdi, Salisbury Park.
3. Outer Pune City: North-West (Aundh-Ganeshkhind), West (Kothrud, Karvenagar, Paud road until Chandni Chowk), South-West (Dattawadi, Sahakarnagar, Dhankawadi), South-East (Bibvewadi, Lullanagar, Upper Kondhwa), East (Ghorpadi, Fatimanagar, Wanowrie, Hadapsar south)

4. Suburbs of Pune City: North-West (Baner, Pashan), West (Bavdhan, Warje), South-West (Wadgaon, Dhayari, Ambegaon), South-East (Katraj, Lower Kondhwa, Undri, Mohammedwadi), East (Hadapsar north, Mundhwa, Manjri), North-East (Wadgaon Sheri, Kharadi), and North (Dhanori, Kalas).

PCMC contains Sangvi (and surrounding areas such as Dapodi, Wakad, Hinjewadi, Pimple Nilakh, Pimple Gurav), Pimpri (and surrounding areas such as Chikhli, Kalewadi, Kasarwadi, Phugewadi, Pimple Saudagar), Bhosari (and surrounding areas such as Moshi, Dighi, Dudulgaon, Charholi Budruk), Chinchwad (and surrounding areas such as Thergaon, Tathawade, Talawade) and Nigdi-Akurdi
Pune is considered as the “Oxford of the East” due to the well-known academic and research institutions in the city and its popularity amongst students. The climate of the city is pleasant and the people are interested in cultural and educational activities. This outlook has enhanced the educational set up of Pune and made it into a center of research and higher education.

Schools in Pune are either run by the Municipality or Private owned trusts or individuals. These schools are either Marathi or English medium in instruction. All the private schools are affiliated to either with the Maharashtra state board (SSC) or the All Indian Certificate of Secondary Education (ICSE) and Central Board of Secondary Education (CBSE) boards. (Wikepedia – Free encyclopedia, Pune city 2008) The recent entry in to the school education is International Bacculerate (IB) board examination with center being at Geneva.

1.13 Operational Definition of Terms.

In the present study the researcher has taken the operational definitions for the related terms as follows:

Cognitive processes: In the study cognitive processes can be stated operationally as Higher mental abilities mentioned by Bloom’s cognitive domain (Sansanwal, 1989). The key terms included in this are: Bloom, 1956 (cited by Linn & Gronlund, 1995)

1. Application: It refers to the ability to use the learned material in new and concrete situations. It may include the application of rules, methods, concepts, principles, laws and theories.
2. **Analysis**: Refers to the ability to break down material into its component parts so that its organizational structure may be understood. This may include the identification of the parts, analysis of the relationships between parts, and recognition of the organizational principles involved.

3. **Synthesis**: Refers to the ability to put parts together to form a new whole. It stress on the formulation of new patterns or structures.

4. **Evaluation**: Refers to the ability to judge the value of material for a given purpose. The judgment is based on definite criteria. These may be internal criteria (organization) or external criteria (relevance to the purpose). This level is the highest in the hierarchy because they contain elements of all the other categories.

**Concept map**: It is a special form of a web diagram for exploring knowledge and gathering and sharing information. Concept mapping is the strategy employed to develop a concept map. A concept map consists of nodes or cells that contain a concept, item or question and links. The links are labeled and denote direction with an arrow symbol. The labeled links explain the relationship between the nodes. The arrow describes the direction of the relationship and reads like a sentence (Novak, 1984).

**Academic Achievement**: Attempt to measure what an individual has learned – his or her present level of performance. (Best & Kahn 2003)

**Students’ of Standard VII**: Refers to the male or female individuals falling approximately in the age group of 11-13 years.

**General Science**: In the present study General Science denotes selected units of Chemistry and Biology.
Pramila Group Test of Intelligence (PGTI): A group test of intelligence in English for the pupils of age group 9 to 13 years (class group V to VII) standardized on 10373 students. (Ahuja 2003)

Test of Higher Mental Ability in General Science (THMAGS): It is a teacher made tests. Where the test items were selected on the basis of the NCERT syllabus and analyzed with three coeducational schools following ICSE pattern. Test construction is dealt in detail in chapter IV.

Unit Test II: It is a teacher made achievement test based on the selected units for study containing only higher order cognitive domain test items. Detail description is given in Chapter III.

Achievement Test (Unit test I): It is a teacher made achievement test based on the selected units for study containing all the levels of cognitive domain beginning from the knowledge level. Construction is dealt in detail in Chapter III.

Trifone Opinionnaire: Is a Concept mapping opinionnaire developed by Trifone (2006) and used in his study The questions were formulated to assess students on the "basis of their perceptions of how concept mapping: (1) affected their level of effort, and active role expended in learning Biology, (2) served as an aid to understanding and achievement, (3) affected their ability and motivation to learn Biology. Trifone (2006).

1.14 Research Design

The test design selected for the study was Quasi – Experimental Design. Group Matching to balance the experimental and control groups (Best & Kahn 2003). The variables were studied using pre - post design.
1.15 Conceptual Frame Work of the Research.

Figure: 1.2 Conceptual Frame Work of the research

1.16 Organization of the Thesis

Chapter one deals with background of the study, the context of the problem, the statement of the problem, and the significance of the study. Also from the statement of the problem research questions, objectives and hypotheses were formulated for the study. The limitations and delimitations, and definitions and operational definitions of the study are also mentioned.

In the second chapter various problem areas under study are reviewed. The theory base of concept map, the philosophical foundations of concept map is discussed. Since Concept maps are included in Graphic Organizers a brief survey of different types of Graphic Organizers are mentioned along with its use. The concept
maps can be confused with mind maps, hence mind maps are explained and the difference is also highlighted. In this chapter the characteristics of concept maps are discussed and steps in the construction of concept maps are also described. A good concept map and a poorly made concept map are displayed so that one might know to construct a meaningful map. After thorough description of the maps, researches related to concept map done in India and abroad are discussed.

Chapter three deals with the methodology of the study. The design of the experiment is quasi – experimental and is discussed at the first part of the chapter followed by the plan of the study. Then the variables selected for the study is discussed. The discussion is then focused on the experimental validity and the techniques used to control the threats to internal and external validity. The population and the procedure of the selection of the sample are also described. Later justification for a small sample is discussed followed by the instruments used in the study. The instruments used in the study, and their construction is explained in detail, along with item analysis, validity and reliability of the test were found out. In the procedure of the study content analysis is done, a comparison with the text book and the syllabus is prepared, and the reason of the selection of the topic is clearly explained. Further pedagogical analysis is done, lesson plans using concept maps are explained and the process of the treatment is discussed to a larger extent. The precautions taken during the experiment and a note on the problems faced during the study are also mentioned.

Chapter four deals with the construction of the THMAGS test. The preliminary discussions and planning of the test construction is dealt in the beginning of the chapter. The importance of instructional objectives and Blooms taxonomy is discussed followed by the objectives and weight ages to the objectives. The
opinionnaires of the experts, the content of the test, selection of test items from various sources such as ASSET, TIMSS were discussed, followed by the implementation in various schools. The chapter also discusses the table of specifications for the THMAGS, item analysis, the degree of difficulty of test items and validity and reliability of the test.

Chapter five deals with the critical analysis of the data. The chapter begins with the procedure of matching the sample using PGTI followed by the design of the collection of data and then analysis of each hypothesis.

Chapter 6 deals with Discussion, Conclusion and Recommendations for the study. Each hypothesis is taken and the results were discussed in depth with the support of the earlier researches. Conclusions were drawn of the study and future line of study was also recommended.